STAR Annual Safety Review

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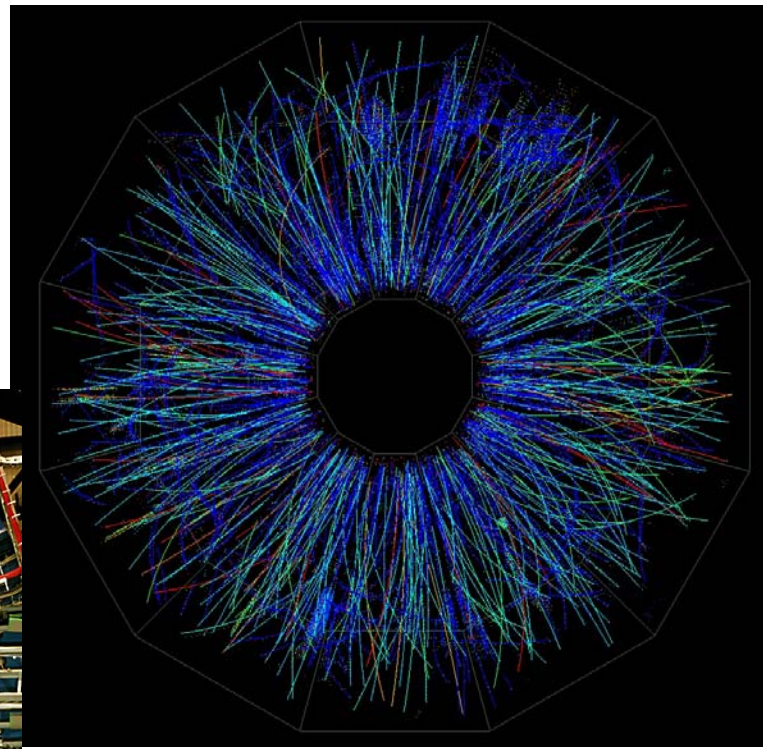
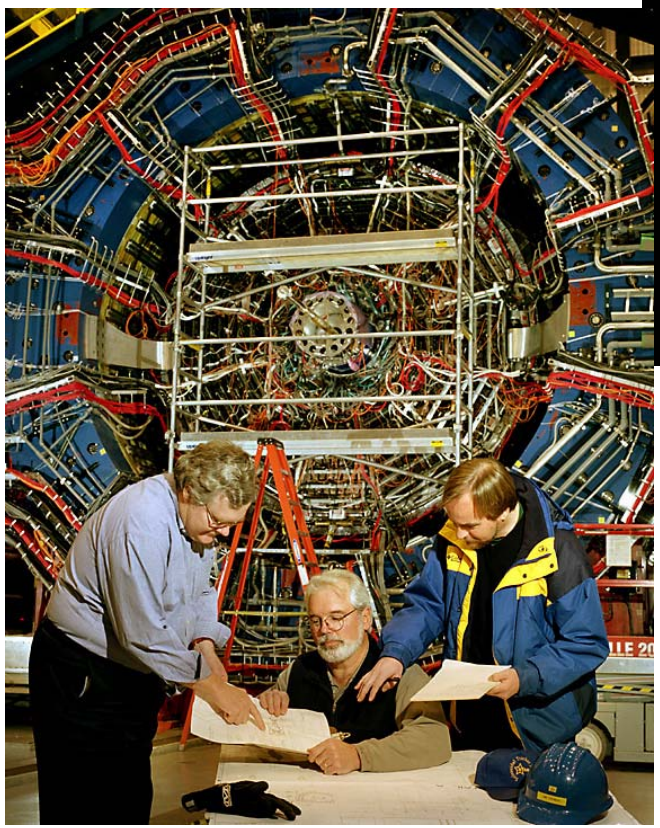
October 31, 2002.

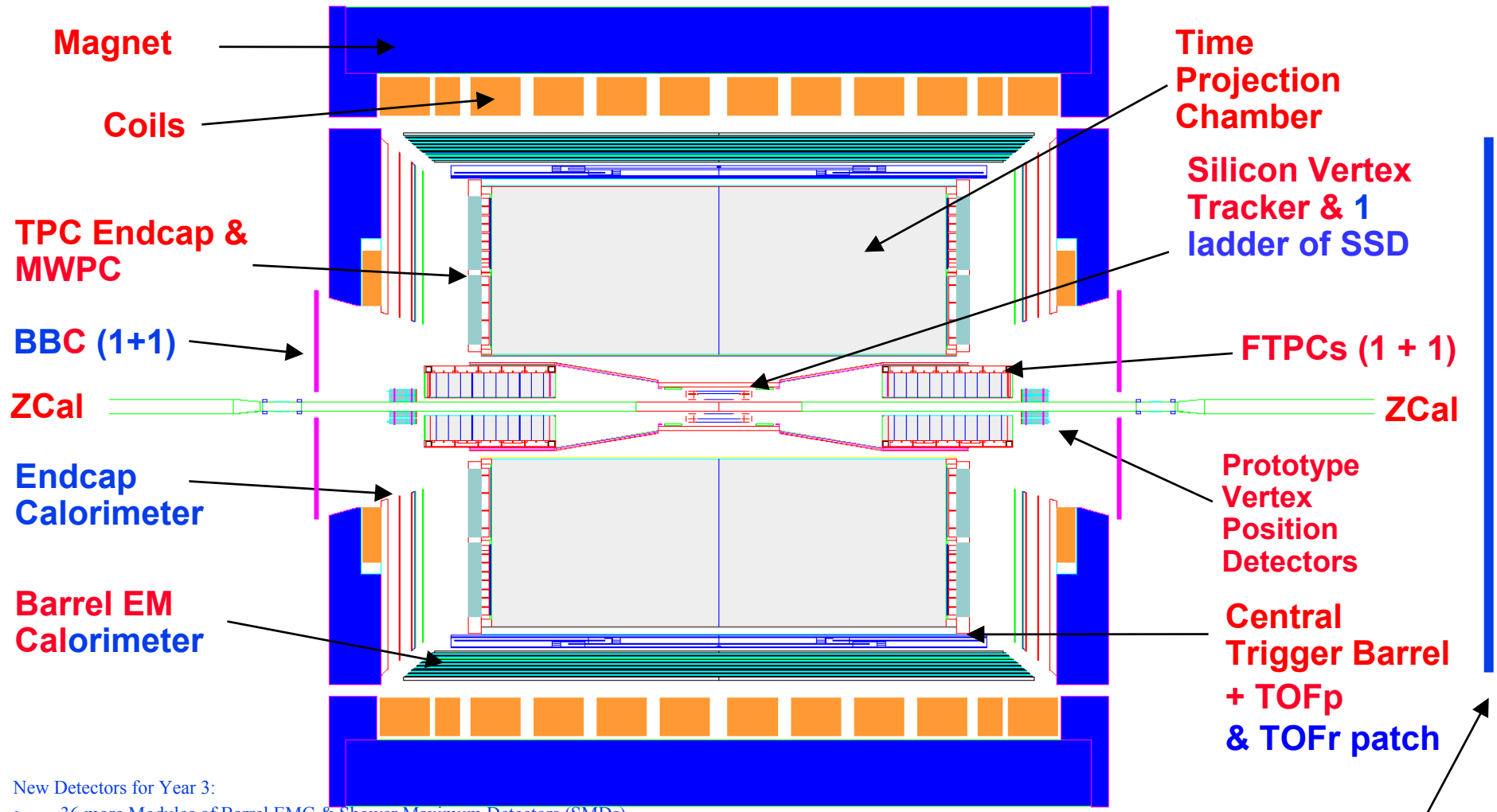


Outline

- The STAR Detector for Year 3
- Plan for Operations/shifts
- Walkthrough of Sub Systems
- Interlocks
- Summary



The STAR Detector for the FY03 Physics run



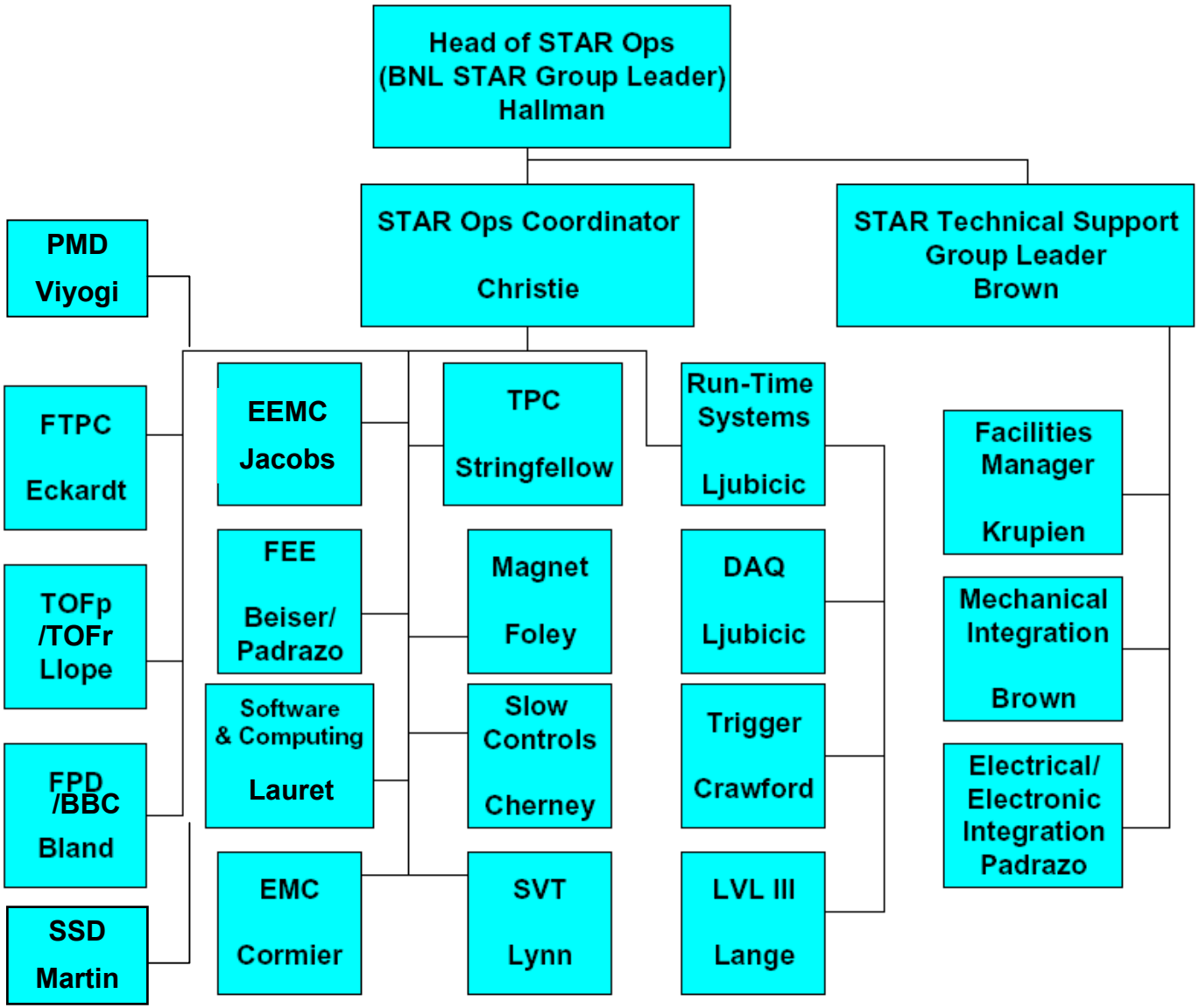
New Detectors for Year 3:

- 36 more Modules of Barrel EMC & Shower Maximum Detectors (SMDs)
- Complete Beam Beam Counters (BBC)
- One half of Endcap calorimeter
- Photon Multiplicity Detector (PMD)
- One ladder of Silicon Strip Detector (SSD)
- One tray of MRPC Time of Flight detector
- Forward Pion Detectors

Red = In system for FY02 run

Blue = New for FY03 run

Plan for Operations and Shifts



Plan for Operations and Shifts

- Shift Staffing Plan (No substantive changes)
  - Shift Leader
  - Detector Operator
  - Run Control/Trigger/QA
  - Online QA/OfflineQA/Online Log
    - Shift term will be 8 days (one day of overlap)
    - Shift crew will be stable (i.e. same set of people) for duration of shift

Sub Systems - Time Projection Chamber (TPC)

1. Configuration: Full TPC used

Small MWPC gain chamber mounted inside the TPC return gas manifold (west side at 12:00). Chamber has a 100 microcurie Fe55 source inside. HV is interlocked the same as the TPC.

2. Voltages:

TPC inner sectors	1170 V
TPC outer sectors	1390 V
Gain Chamber	1400 V
TPC Cathode	Up to 35 kV (nominal 27.0)
Gated grid	115 V with a swing of +-75 V
FEE & RDO power	+/- 8V
Two lasers with no exposed beams	

3. Gas system:

Main TPC gas is P10 (10% Methane, 90% Ar)

Purge flow rate = 120 lpm for a total of 3 volume exchanges (TPC volume = 50,000 l)

Normal recirculating flow = 560 lpm with 14 lpm vented out the stack (stack located on the east wall of the STAR assembly building with the vent exit above the level of the berm retaining wall.)

Insulating gap gas is N2 - flow rate is 10 lpm out the vent stack.

N2 is also used in various places in the gas system, laser system and water system - total flow ~ 50 lpm vented to the room.

New Liquid Argon tank removes need to deal with many small liquid Argon dewars.

Gas system control interfaces upgraded to use commercial systems.

4. Water cooling - the TPC FEE & RDO are cooled by a closed loop water cooling system. Heat exchange is to the STAR MCW. Total volume is ~500 gallons and flow rate is 320 GPM. The system is located in the second floor utility room at STAR. No water is released to the environment.

5. Safety interlock: The TPC has an Allen-Bradley SLC interlock system. The main system is located in the gas mixing room, with a remote slave system located on the second floor south platform. The SLC is used for equipment protection, and is closely linked to the STAR SGIS. The TPC system provides interlocks and alarms for the TPC HV and LV. Adding small delays (~1 s) in kill signals, and adding surge suppressors to system.

6. No new procedures.

Sub Systems - Silicon Vertex Tracker (SVT)

1. Configuration: Full SVT used
(3 barrels = 36 ladders = 216 wafers = 103,680 channels)

2. Voltages:

SVT high voltage 1500 V (fully enclosed, I < 9 mA)
FEE & RDO power +/- 8V
calibration voltages < 20V
Two class TBD lasers with no exposed beams

3. Gas system: no gas system

4. Water cooling:

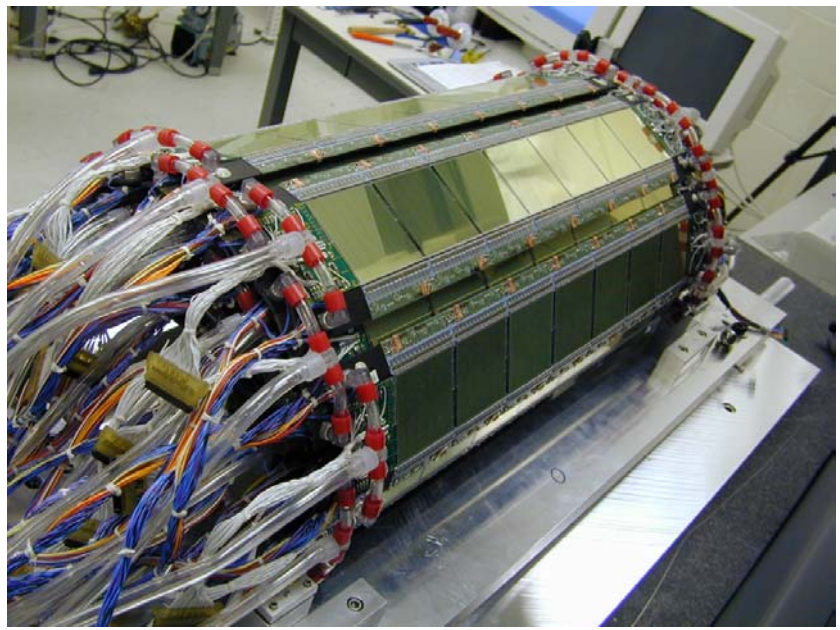
a.) the SVT front-end electronics (on-detector) are cooled by an independent closed loop water cooling system. Heat exchange is to the wide angle hall. Total volume is ~45 gallons, the volume of water in the system is 32 gallons. The maximum system pressure is 30 psig, however all elements inside the SVT are below atmospheric pressure. The nominal flow rate is 6 gpm at a nominal water temperature of 75 F. The system is located on the first floor of STAR North platform in the Wide Angle Hall. No water is released to the environment.

b.) the SVT RDO boxes are cooled by the TPC RDO closed loop water cooling system. The nominal flow rate through the RDO boxes is 12-19 gpm.

5. Air cooling:

a.) the SVT is air-cooled from outside the TPC wheel. An air manifold is mounted to the TPC wheel. The air is pumped into the SVT volume from the West Side and released to the Wide Angle Hall on the East Side. The operating pressure will be less than 0.8 in. H2O (2 mbar). The shut off pressure is 2 in. H2O (5 mbar)

The nominal temperature is 75 F and the maximum flow rate is 600 cfm (17000 lpm), however we expect much less.



Sub Systems - Silicon Vertex Tracker (SVT)

6. Safety interlock:

The SVT has a custom-made relay driven interlock system for equipment protection. The main STAR system is located on the STAR south platform (2nd floor). The system is closely linked to the STAR SGIS. The SVT system provides interlocks and alarms for the SVT HV and LV, plus RDO crate over temperature and the RDO water system flow and temperature. In order to turn on the SVT-LV the following permissions have to be granted:

a.) global (from SGIS) (requires tpc water flow, inner field cage air flow and all other global locks)

b.) no-leak (from trace-tek via TPC Allen Bradley) (requires no water leaks in any connected system)

c.) SVT water (from thermal dispersion flow switch located in svt water system) (requires SVT water is flowing)

d.) SVT water temperature (from temperature switch in svt water system) (requires that svt water temperature does not exceed 100 F).

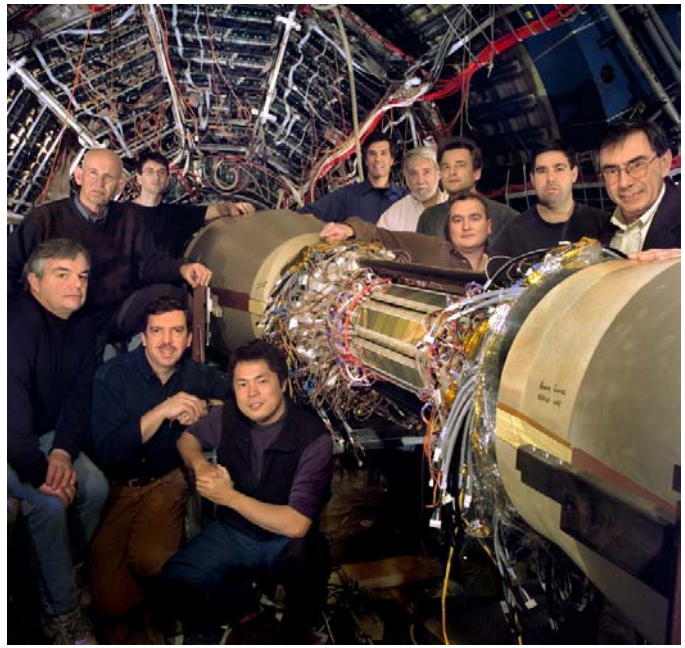
e.) Water pressure less than zero. SVT water, power, and HV shutdown if water pressure is/becomes positive.

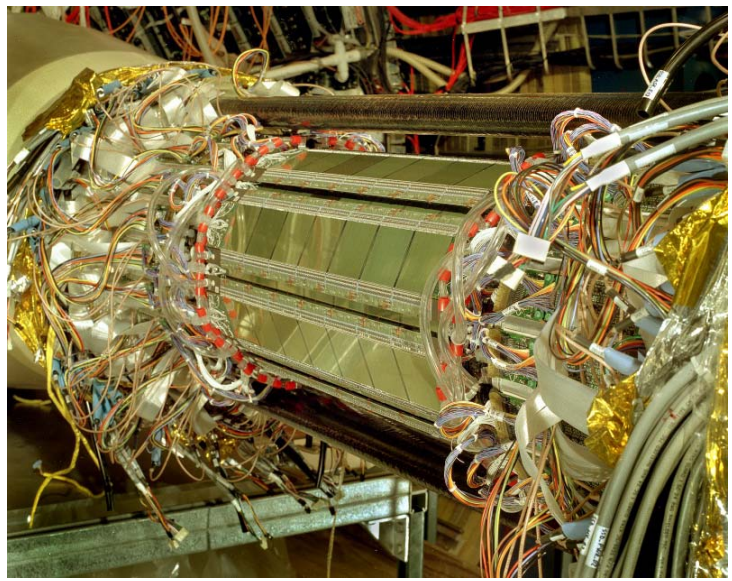
The SVT-HV can only be turned on if the SVT-LV is on.

The SVT leak detection is also incorporated into the STAR SGIS.

In case of a leak the SVT water pump will shut off.

7. No new procedures.





Sub Systems - Forward TPCs (FTPC)

1. Configuration:

i) Both FTPCs in the same configuration as for the previous run.

ii) 2 TPC lasers used; no open beam

2. Voltages:

Anode voltage (readout chambers) :1750+/-50 V

Anode voltage (DVM) : 1200+/-50 V

Drift voltage (FTPC) : 12.5+/-.5 kV

Drift voltage (DVM) : 6 kV

Low voltage (FEE + RDO) : +/-8 V

Gating grid voltage : 180 V

3. Gas system:

Gas mixture: Ar/CO2 (50/50)

Purge flow: ca. 200 l/h and chamber

Operation flow: 50 - 100 l/h and chamber (in purge mode, will be higher in circulation mode)

Location: Gas mixing room

Exhaust to gas mixing room

4. Water cooling:

Water cooling for FEE and RDO boards

Supply system is closed circuit at low pressure (leakless) with heat exchanger to MCW

Total water volume: < 10 gallons

Flow: < 1.0 g/min

Supply system is located on 1. level on North platform

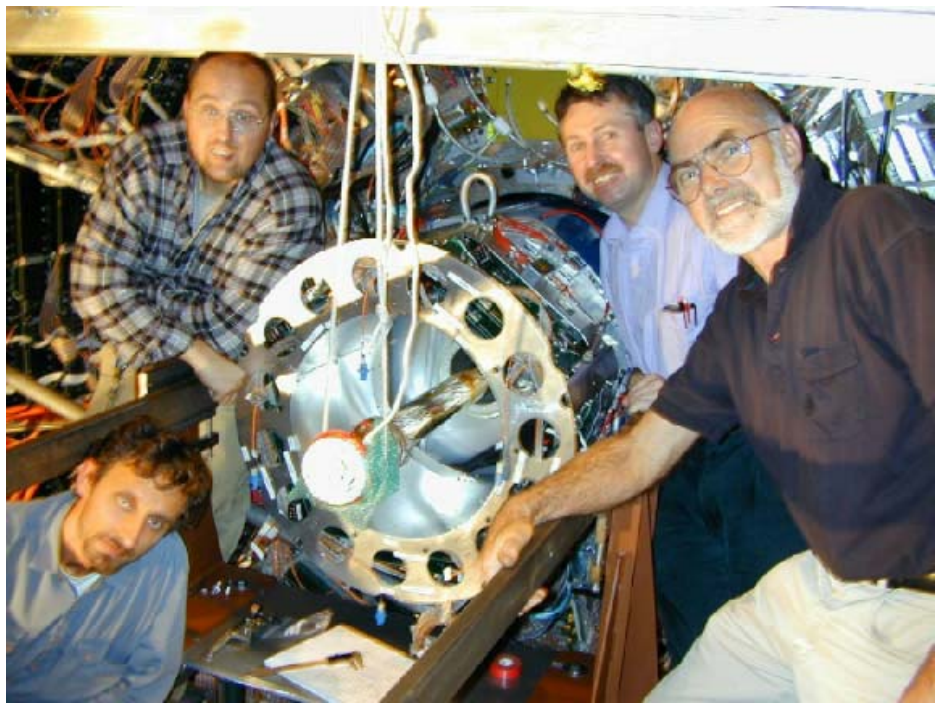
No water release to environment

5. Safety interlock:

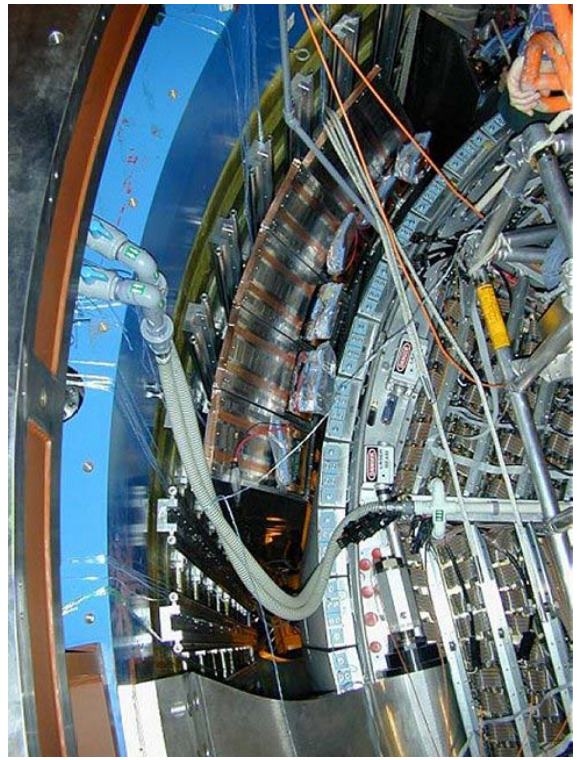
The FTPC interlock system is closely linked to the SGIS (Star General Interlock System) and the TPC interlock. TPC interlock outputs are fed into the FTPC system and are processed through a relay ensemble to control LV and HV. LV are also interlocked to the FTPC cooling system.

Under development, and expected to be operative before the run starts, are the HV interlock that inputs from the FTPC gas system and the cooling system interlock connected to the STAR water detection system.

5. Procedures: No new procedures for run 3.



Sub System - Barrel EMC



1. Configuration: 60 EMC modules instrumented for the start of RHIC FY03 run period. The modules are arranged to give complete (360°) azimuthal coverage on the West end of STAR.

3. Voltages:

EMC barrel PMT: 1470V fully enclosed and less than 10ma.
SMD wires: 1430V operating, 1500V maximum fully enclosed and less than 10ma.
FEE & RDO power: +/- 8V max.

No lasers.

4. Water cooling: The SMD FEE electronics are cooled by a closed loop water cooling system.

5. Safety interlock: The EMC has a relay based interlock system. A feed from the TPC interlock system includes water leak detection and HV and LV permissives from STAR.
EMC local interlocks include:
SMD water system flow and temperature
Crate power supply over voltage and overcurrent.
Crate over temperature.
SMD FEE over temperature.

Barrel Shower Maximum Detector (SMD)

1. Configuration:
60 modules and conventional systems for them installed (out of 120 for full system).

Notes: SMD Modules require High Voltage, Gas Flow, Water Cooling and all grounds are electrically isolated from the EMC and each other.

2. Voltages:
High Voltage supplied by Lecroy 1454 Crate located at 12 o'clock on BL1W and LeCroy 1445 located near BL8E (below magnet, East side).

SMD HV - 1430 V

3. Gas System:
Gas Bottles/Initial Supply Manifold located immediately outside door of gas utility room in STAR hall. Stepdown regulator located on third floor south platform of STAR Detector. Bubbler arrays located at 10 o'clock/2 o'clock West positions on backleg steel and West side magnet supports near 8 o'clock/4 o'clock positions.

SMD Gas is 90%Argon-10%Carbon Dioxide at low flow and atm. pressure.

Maximum Supply Pressure to Modules is 9 PSI

Pressure inside the SMD module -
12 mm H2O above atmospheric at nominal gas flow.
Total Gas Volume ~ 120,000 cm**3

Modules are ganged together in pairs, i.e. 60 modules = 30 pairs
Nominal Flow Rate - 10 cm**3/min /module
Total Nominal Flow rate - 240 cm**3/ min

Gas is low flow, low pressure and non-hazardous.
Accidental overpressure of supply line (>50 PSI) vented outside building.
Gas is vented outside magnet thru system of bubblers into hall.
Gas Flow is monitored by remote TV cameras on array of bubblers.

4. Water Cooling:
The SMD FEE are cooled by a closed loop water cooling system.
Heat exchange is to the STAR MCW.
Total volume is ~ 1 liter, total flow rate ~ 100 cc/s.
Cooling water circuit supply/return rings on West end of Magnet.
Routing to detectors through plastic hoses with separate shutoff valves at 6 places around the ring on the West end of the magnet.
Water may be shut off at manifold on NorthWest floor level of STAR detector.

No water is released to the environment.

Supply Pressure = 110-120 PSI
Return Pressure = 23 PSI

All circuits pressure rated to 245 PSI @ 100F
Installed heat-exchangers tested to 150 PSI to UCLA, all circuits tested being installed to 110-120 PSI.

5. Safety Interlocks:

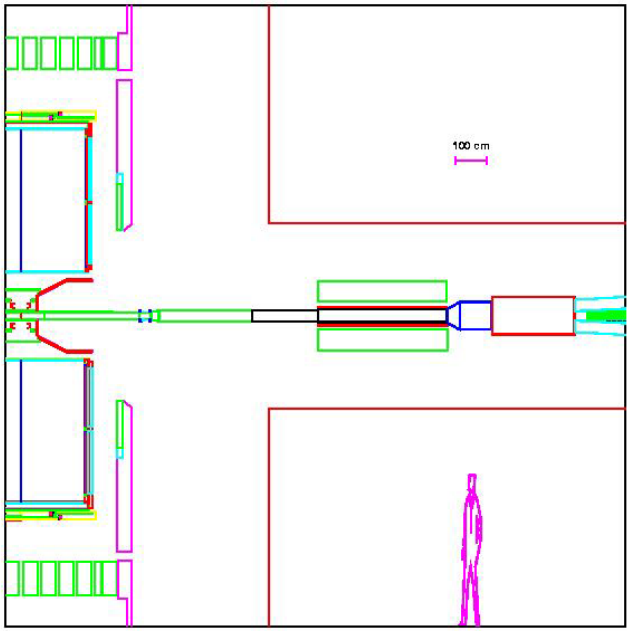
High Voltage has hardware interlocks similar to the SVT subsystem.

Front End Electronics has temperature-sensors to shut off low voltage in case of loss of chilled water.

Gas system has a vent valve outside of the building in case of accidental overpressure of the supply line.

Sub Systems - Trigger

Zero Degree Calorimeters (ZDC) Coincidence.



1. The CTB will operate with 118 of 120 trays installed.

2. a. The PMT voltages are from current limited LeCroy supplies set for maximum HV of 2200 V.

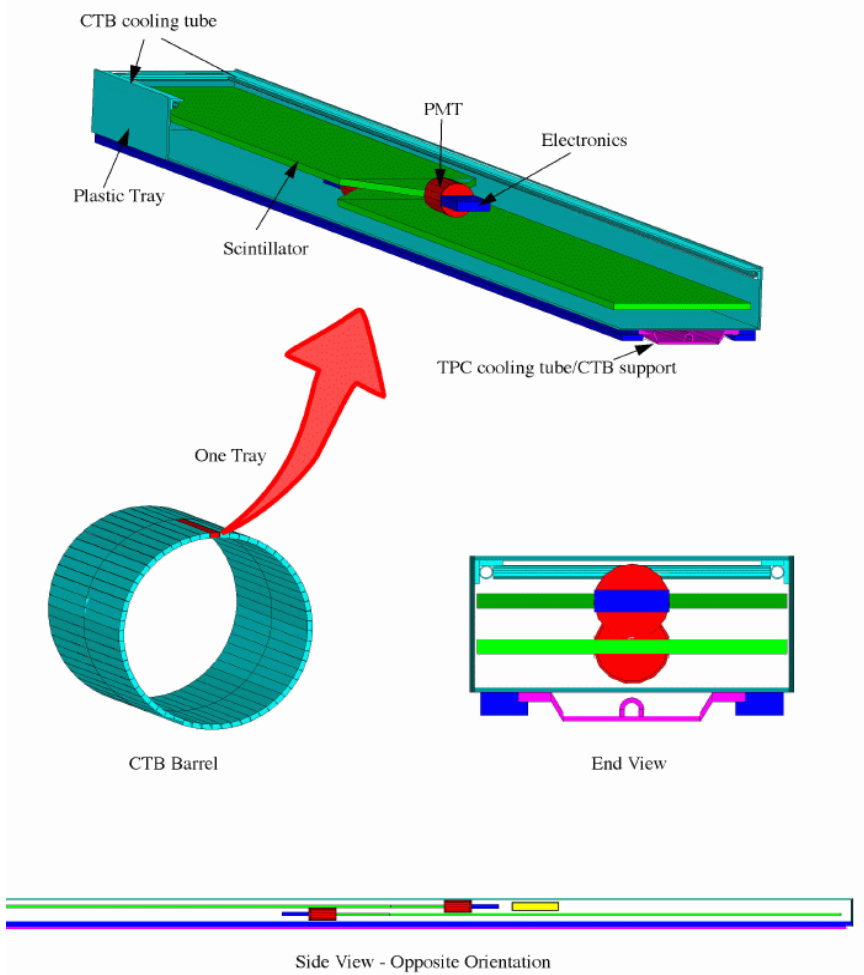
b. 10 VME crates operate at 220V and 2.3kW each.

3. no gases 4. no liquids

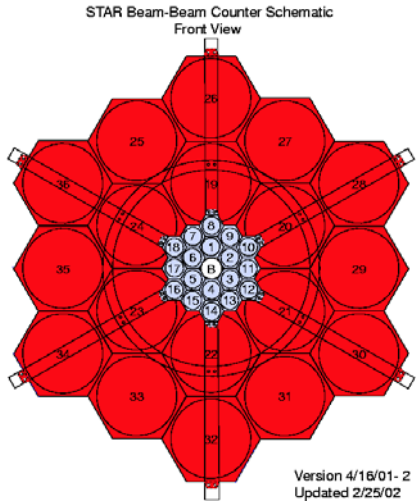
5. One Trigger operations manual in the process of updating for the current run.

Essentially No Changes from Last Year

Central Trigger Barrel (CTB) Summed ADC Threshold.



Beam Beam Counter (BBC)



1. Configuration:

- Plan is to install and instrument the large outer tiles for FY03 run. PMT boxes have been expanded to accommodate 24 PMTs each (E & W).

- Readout will be via “trigger” electronics this year.

2. No gas system or water cooling.

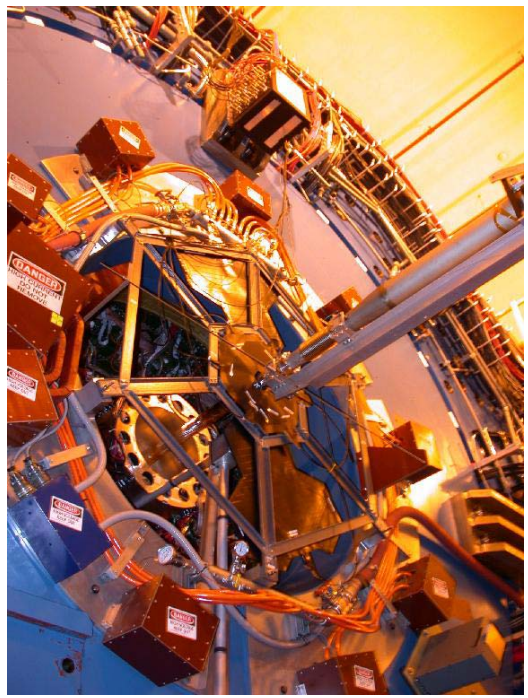
3. Voltages:

- The PMTs for the BBC operate at an average cathode voltage of -1400 V.

- The HV is supplied by a LeCroy 1440 system located on the South Electronics platform

4. Interlocks:

The electronics and HV systems for the BBC are housed in electronics racks on the South platform. These are standard STAR racks and have have standard STAR interlock features (e.g. rack based smoke and water leak protection, power shutdown via SGIS).



Patch TOFs (pTOF), (TOFr) & VPDs

Time of Flight Patch (TOFp)

- One tray which replaces a CTB tray
- Contains 45 scintillator slats and PMTs
- Water cooling
- Same as last year

Prototype Vertex Position Detector (PVPD)

- Each pVPD contains three PMTs
- Located on each side of STAR, on beampipe support
- Same as last year

Resistive Plate TOF patch (TOFr)

- One tray which replaces a CTB tray

Gas System:

- R134A, 63ccm
- isobutane, 3.5ccm
- SF6, 0-3.5ccm

all vented to the atmosphere, outside through a stack

Voltages Used:

HV - +/-8kV, <50nA, total for MRPCs

LV - +/- 8V,

- 1.2V for disc threshold

Interlocks:

pVPD and TOFp systems: same as last year.

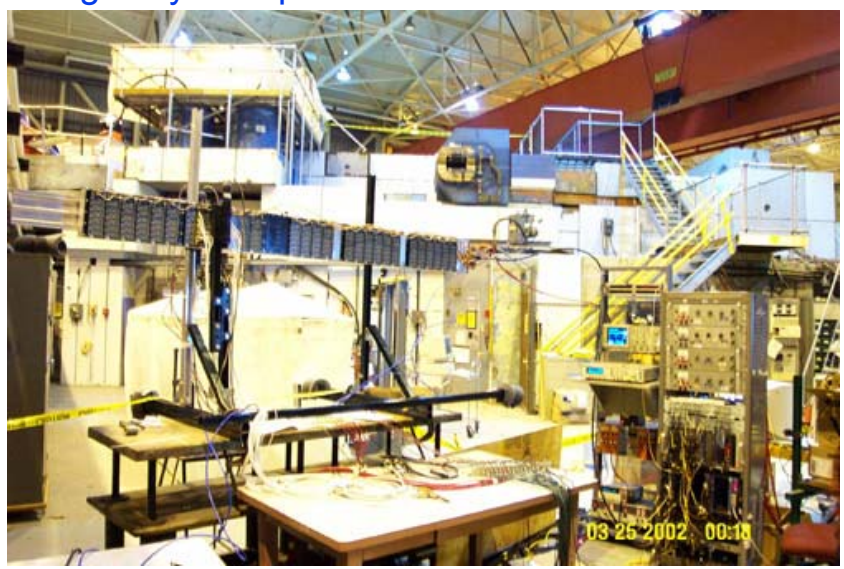
TOFr:

Power to racks is dropped upon loss of STAR global interlock. This drops HV and LV. Interlocks also in gas mixing room. Senses for isobutane content. Stop gas flow upon loss of SGIS gas permissive.

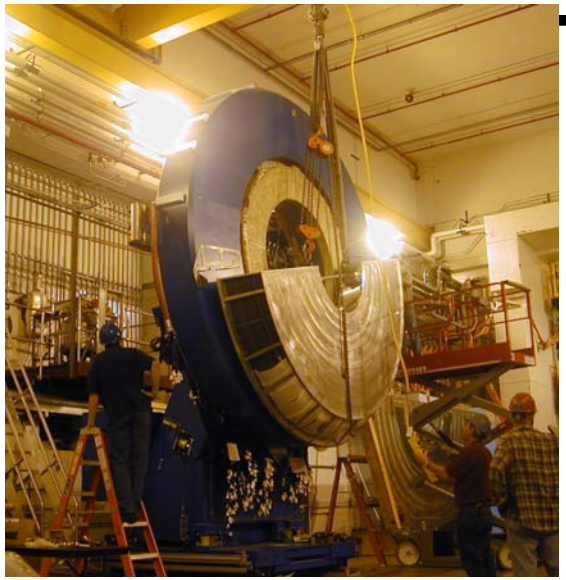
Procedures:

HV and LV same as for TOFp

New gas system procedures to be written.



New Sub System – Endcap EMC (EEMC)

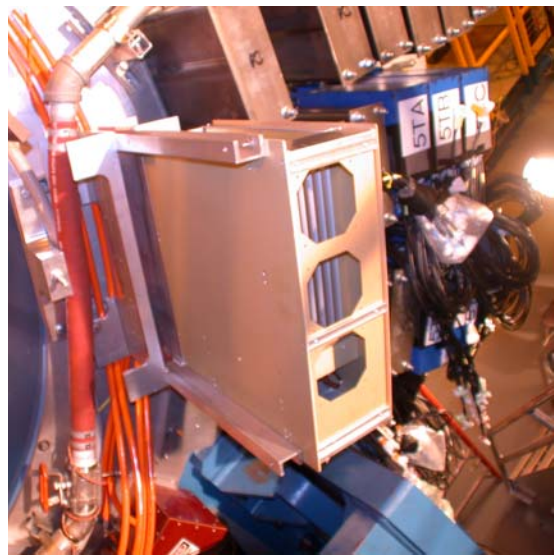


Configuration: Lower ½ structure on west STAR poletip; four 30° sectors (#5,6,7,8,) loaded with tower scintillator megatiles and extruded strip Shower Maximum (SMD) modules.

Instrumentation: Magnetically shielded PMT boxes and readout for 240 towers (4 sectors) on back of poletip. Readout of Multi-Anode PMT boxes for at least one sector of SMD, PreShower and PostShower layers added during run.

Power & Interlocks: Supplies and electronics crates in rollaround racks w/ shore or platform power; local smoke alarm trips rack shunt breakers.

Voltages: HV (~ 1000V) for PMT/MAPMT supplied via CW bases; HVSys made controller supplies 160V and safety shutdown features; LV power (WIENER) supplied remotely to tower crates at ±5V, ±12V and MAPMT box FEE electronics via distribution panels at ± at 7V, +4V.



Water Cooling: MAPMT boxes cooled by commercial closed-loop chiller system with ~ 10 gallon total volume; local safety interlocks.

Laser: Nd/YAG (λ=355nm), primary 11mJ/pulse @ 10Hz; west tunnel operation enclosure, split and delivered via (closed) fiber distr network ; misc. monitoring PMT's, diodes and electronics

Sources: sealed 300 μCi ^{60}Co used only in test/calibr mode when poletip is removed from STAR; small alpha test sources enclosed in level #2 laser splitter boxes on back of poletip.

Reviews: Install/Safety 3/13/02; Electrical Safety 9/3/02

New Sub Systems - Silicon Strip Detector (SSD)

1. Configuration: One SSD ladder

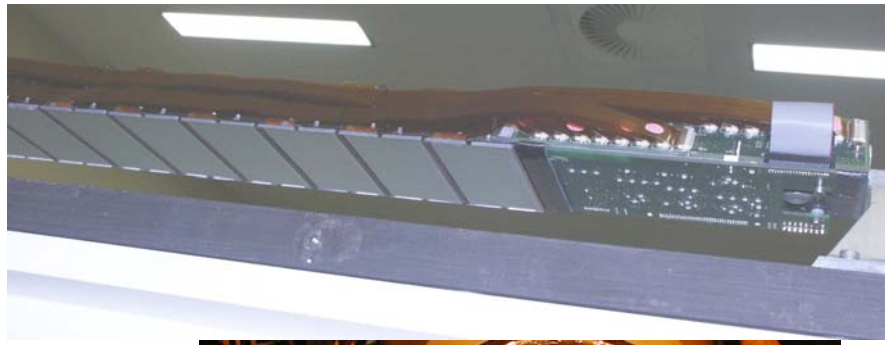
(Full configuration = 1 barrel = 20 ladders = 320 wafers = 491,520 channels)

2. Voltages:

SSD Wafer : 35 V (I_{op} < 200 μA, I_{max} < 1 mA)

FEE power : +/- 2V

ADC, Control and RDO power : +7V, +5V



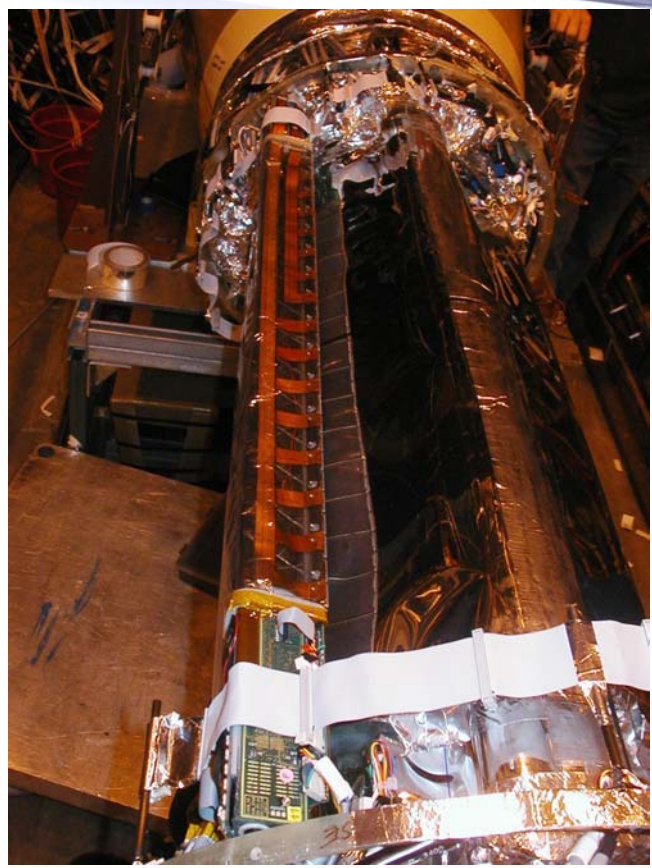
3. No water cooling or gas system.

4. Air cooling : The SSD ladder and its RDO boards are air-cooled. The air is taken from the IFC, pulled through the ladder and released to the WAH. Two vortex (transvector airflow amplifier) installed on the Pole Tips use 8 bars compressed air and induce an airflow (1 liter/s). The nominal temperatures are : 30°C on the wafers, 35°C on the ladder boards and 60°C on the RDO boards.

5. Interlocks : The SSD interlock system is closely linked to the SGIS. It uses a custom-made relay driven system integrated in the SSD slow control crate located on the STAR south platform. The SSD power supplies and the cooling system can be turn on only if the following permissions are granted :

- IFC permissive (from SGIS)

The internal Slow Control allows one to monitor the wafer and board temperatures and to turn off the SSD voltages in case of an air cooling system failure.



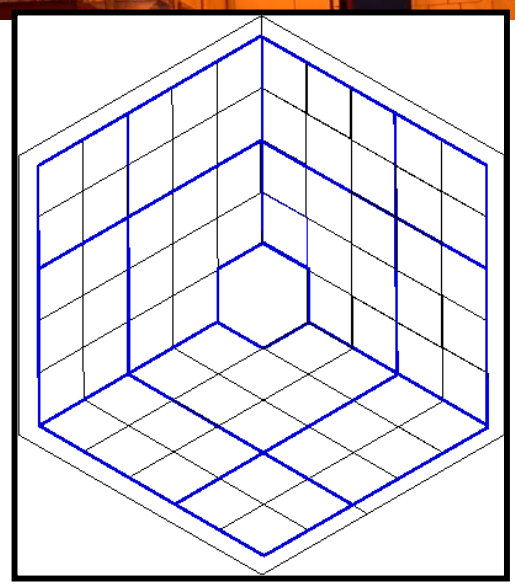
New Sub system, Photon Multiplicity Detector (PMD)

1. Configuration: It is likely that less than the complete PMD detector will be in place for the FY03 run. Expect

- All rack mounted electronics in place
- Full gas system in place
- Full beam support system in place
- Some portion of detector modules

2. Gas System:

- PMD gas system is a single pass design that uses premixed gas.
- Gas composition is 70% Argon & 30% CO2
- Total flow rate is ~ 50 l/hour
- Gas is vented to gas mixing room



3. Voltages:

- HV is provided by LeCroy 4032A supply
- Detector is operated at - 1450 V
- LV is $\pm$ 2.7V, provided by Weiner commercial supply

4. Interlocks:

- Local smoke interlock on racks, SGIS power crash button

5. Procedures:

- System will be run by experts for FY03 run

Changes to SGIS Interlock System

- Meeting was held on Oct. 24th to discuss changes to SGIS system. Document produced that compiles changes to STAR Interlock systems for FY03 run
- Schedule calls for changes to SGIS to be implemented, and interlocks system certification (I.e. “Blue sheet”) to be completed by November 15th.
- SGIS work must be completed, and “Blue Sheet” certification completed before we can introduce P10 into STAR.

Summary

Note: Environmental Emissions Document is complete for FY03

Still Pending:

- **Develop/update Detector Specific Procedures for operation of new/old Sub Systems, as necessary**
  - **PMD, EEMC, and SSD likely to be operated by experts for entire FY03 run**
- **Get SGIS and Interlock updates done and certified**